

JAPAN

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JIS B 9707 (2002) (English): Safety of machinery
-- Safety distances to prevent danger zones being
reached by the upper limbs

ISO INSIDE

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*The citizens of a nation must
honor the laws of the land.*

Fukuzawa Yukichi

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JAPANESE
INDUSTRIAL
STANDARD

Translated and Published by
Japanese Standards Association

JIS B 9707 : 2002

(ISO 13852 : 1996)

**Safety of machinery—
Safety distances to prevent danger
zones being reached by the upper
limbs**

ICS 13.110; 13.180

Reference number : JIS B 9707 : 2002 (E)

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Foreword

This translation has been made based on the original Japanese Industrial Standard established by the Minister of Economy, Trade and Industry, and the Minister of Health, Labour and Welfare through deliberations at the Japanese Industrial Standards Committee in accordance with the Industrial Standardization Law:

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Safety of machinery— Safety distances to prevent danger zones being reached by the upper limbs

Introduction This Japanese Industrial Standard has been prepared based on the first edition of **ISO 13852** *Safety of machinery—Safety distances to prevent danger zones being reached by the upper limbs* published in 1996 without modifying the technical contents.

The foreword of the original International Standard has been excluded from this Standard because it is not part of the provisions. Also, the portion of introduction of the original International Standard which is described in another standard has been excluded from this Standard.

One method of eliminating or reducing risks caused by machinery is to make use of safety distances preventing danger zones from being reached by the upper limbs.

In specifying safety distances, a number of aspects have to be taken into consideration, such as:

- reach situation occurring when machinery is being used;
- reliable surveys of anthropometric data, taking into account ethnic groups likely to be found in the countries concerned;
- biomechanical facts, such as compression and stretching of parts of the body and limits of joint rotation;
- technical and practical aspects.

If the aspects were further developed, the current state of the art, reflected in this Standard, could be improved.

1 Scope This Standard establishes values for safety distances to prevent danger zones being reached by the upper limbs of persons of 3 years of age and above. The distances apply when adequate safety can be achieved by distances alone.

NOTE 1 These safety distances will not provide sufficient protection against certain hazards, for example radiation and emission of substances. For such hazards, additional or other measures need to be taken.

The safety distances protect those persons who try to reach danger zones without additional aid and under the conditions specified for the different reaching situations.

This Standard need not be applied to machinery which is covered by certain electrical standards in which specific testing procedures are laid down, for example using the test finger.

For certain applications there are justifiable reasons to deviate from these safety distances. Standards dealing with these applications indicate how an adequate level of safety can be achieved.

NOTE 2 The International Standard corresponding to this Standard is as follows.

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standard and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21**.

ISO 13852 : 1996 *Safety of machinery—Safety distances to prevent danger zones being reached by the upper limbs* (IDT)

2 Normative references The following standards contain provisions which, through reference in this Standard, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

ISO/DIS 12100-1 *Safety of machinery—Basic concepts and general principles for design—Part 1 : Basic terminology, methodology*

3 Definitions For the purposes of this Standard, the definitions given in **ISO/DIS 12100-1** and the following definitions apply.

3.1 protective structure Physical obstructing which restricts the movement of the body and/or a part of it.

NOTE : For example, a guard or part of a machine.

3.2 safety distances Minimum distance a protective structure shall be placed from a danger zone.

4 Values for safety distances

4.1 General

4.1.1 Assumptions The safety distances have been derived by making the following assumptions:

- the protective structures and any openings in them retain their shape and position;
- safety distances are measured from the surface restricting the body or the relevant part of the body;
- that persons may force parts of the body over protective structures or through openings in an attempt to reach the danger zone;
- the reference plane is a level at which persons would normally stand, but need not necessarily be the floor (e.g. a working platform could be the reference plane);
- no aids such as chairs or ladders are used to change the reference plane;
- no aids such as rods or tools are used to extend the natural reach of the upper limbs.

4.1.2 Risk assessment Selection of the appropriate safety distance for reaching upwards (see **4.2**) or reaching over protective structures (see **4.3**) shall be dependent on a risk assessment (for risk assessment see **ISO/DIS 12100-1**). The risk assessment shall be based on the probability of occurrence of an injury and the foreseeable severity

of that injury. An analysis of the technical and human elements on which the risk assessment is dependent is essential to achieve the appropriate selection from this Standard.

Example 1 Where there is a low risk from a friction or abrasion hazard, the values given in table 1 should be used (see 4.3.2.1).

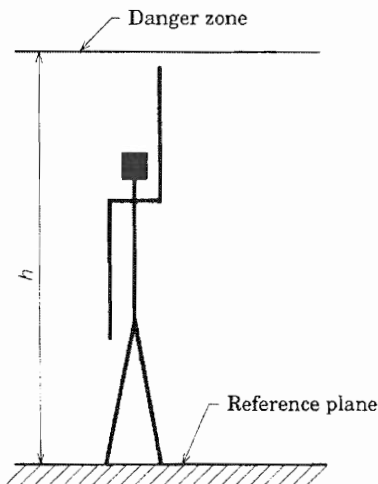
Example 2 Where there is a high risk from an entanglement hazard, the values given in table 2 shall be used (see 4.3.2.2).

4.2 Reaching upwards (see figure 1)

4.2.1 If there is a low risk from the danger zone (see 4.1.2), then the height of the danger zone h shall be 2 500 mm or more.

4.2.2 If there is a high risk (see 4.1.2) from the danger zone, then

- either the height of the danger zone h shall be 2 700 mm or more, or
- other safety measures shall be used.



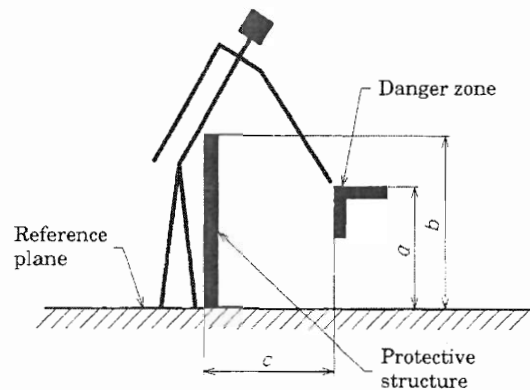
NOTE : h is the height of the danger zone.

Figure 1 (reaching upwards)

4.3 Reaching over protective structures

4.3.1 **Symbols** The following symbols are used (see figure 2):

- a is the height of danger zone;
- b is the height of protective structure;
- c is the horizontal distance to danger zone.



NOTE : For an explanation of the symbols, see 4.3.1.

Figure 2 (reaching over protective structure)

4.3.2 Values

4.3.2.1 If there is a low risk (see 4.1.2) from a danger zone, the values given in table 1 shall be used as minimum values.

There shall be no interpolation of the values given in table 1 (see 4.3.3). Consequently, when the known values of a , b or c are between two values in table 1, values to be used are those which provide the higher level of safety.

Table 1 (case of low risk)

Unit: mm

Height of danger zone, a	Height of protective structure, $b^{1)}$								
	1 000	1 200	1 400	1 600	1 800	2 000	2 200	2 400	2 500
Horizontal distance to danger zone, c									
2 500 ²⁾	—	—	—	—	—	—	—	—	—
2 400	100	100	100	100	100	100	100	100	—
2 200	600	600	500	500	400	350	250	—	—
2 000	1 100	900	700	600	500	350	—	—	—
1 800	1 100	1 000	900	900	600	—	—	—	—
1 600	1 300	1 000	900	900	500	—	—	—	—
1 400	1 300	1 000	900	800	100	—	—	—	—
1 200	1 400	1 000	900	500	—	—	—	—	—
1 000	1 400	1 000	900	300	—	—	—	—	—
800	1 300	900	600	—	—	—	—	—	—
600	1 200	500	—	—	—	—	—	—	—
400	1 200	300	—	—	—	—	—	—	—
200	1 100	200	—	—	—	—	—	—	—
0	1 100	200	—	—	—	—	—	—	—

Notes 1) Protective structures less than 1 000 mm in height are not included because they do not sufficiently restrict movement of the body.
2) For danger zones above 2 500 mm, refer to 4.2.

4.3.2.2 If there is a high risk (see 4.1.2) from a danger zone, then

- either the values given in table 2 shall be used, or
- other safety measures shall be used.

There shall be no interpolation of the values given in table 2 (see 4.3.3). Consequently, when the known values of a , b or c are between two values in table 2, the values to be used are those which provide the higher level of safety.

Table 2 (case of high risk)

Unit: mm

Height of danger zone, a	Height of protective structure, $b^{1)}$									
	1 000	1 200	1 400 ²⁾	1 600	1 800	2 000	2 200	2 400	2 500	2 700
	Horizontal distance to danger zone, c									
2 700 ³⁾	—	—	—	—	—	—	—	—	—	—
2 600	900	800	700	600	600	500	400	300	100	—
2 400	1 100	1 000	900	800	700	600	400	300	100	—
2 200	1 300	1 200	1 000	900	800	600	400	300	—	—
2 000	1 400	1 300	1 100	900	800	600	400	—	—	—
1 800	1 500	1 400	1 100	900	800	600	—	—	—	—
1 600	1 500	1 400	1 100	900	800	500	—	—	—	—
1 400	1 500	1 400	1 100	900	800	—	—	—	—	—
1 200	1 500	1 400	1 100	900	700	—	—	—	—	—
1 000	1 500	1 400	1 000	800	—	—	—	—	—	—
800	1 500	1 300	900	600	—	—	—	—	—	—
600	1 400	1 300	800	—	—	—	—	—	—	—
400	1 400	1 200	400	—	—	—	—	—	—	—
200	1 200	900	—	—	—	—	—	—	—	—
0	1 100	500	—	—	—	—	—	—	—	—

Notes 1) Protective structures less than 1 000 mm in height are not included because they do not sufficiently restrict movement of the body.
2) Protective structures lower than 1 400 mm should not be used without additional safety measures.
3) For danger zones above 2 700 mm, refer to 4.2.

4.3.3 Use of tables 1 and 2 with intermediate values The following examples explain the use of tables 1 and 2 when values other than those given in the tables have to be used. For the purposes of the examples, the values given in table 1 are used.

Example 1 To determine the height b of the protective structure with known values for a and c .

The height a of the danger zone is 1 500 mm and its horizontal distance c from the proposed protective structure is 700 mm.

Using table 1, the height b of the protective structure shall at least be 1 800 mm.

Example 2 To determine the horizontal distance c of the danger zone with known values for a and b .

The height b of the protective structure is 1 300 mm and the height a of the danger zone is 2 300 mm.

Using table 1, the horizontal distance c of the protective structure from the danger zone shall be 600 mm.

Example 3 To determine the height a of the danger zone with known values for b and c .

The height b of the protective structure is 1 700 mm and the horizontal distance c from the danger zone is 550 mm.

Using table 1, the height a of the danger zone shall not be between 1 200 mm and 2 200 mm.

4.4 Reaching round Table 3 shows fundamental movements for persons of 14 years of age and above (see also clause 5).

Table 3

Unit: mm

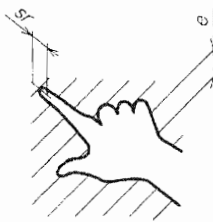
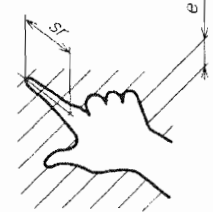
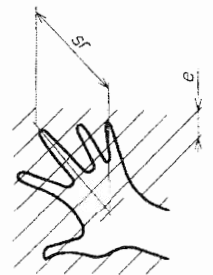
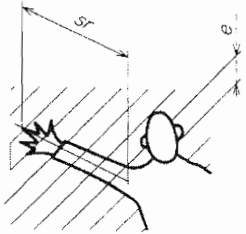
Limitation of movement	Safety distance, sr	Illustration
Limitation of movement only at shoulder and armpit	≥ 850	
Arm supported up to elbow	≥ 550	
Arm supported up to wrist	≥ 230	
Arm and hand supported up to knuckle joint	≥ 130	
<p>A is the range of movement of the arm.</p> <p>Note 1) This is either the diameter of a round opening, or the side of a square opening, or the width of a slot opening.</p>		

4.5 Reaching through openings

4.5.1 Regular openings for persons of 14 years of age and above Table 4 gives safety distances sr for regular openings for persons of 14 years of age and above.

Table 4

Unit: mm

Part of body	Illustration	Opening	Safety distance, s_r		
			Slot	Square	Round
Finger tip		$e \leq 4$	≥ 2	≥ 2	≥ 2
		$4 < e \leq 6$	≥ 10	≥ 5	≥ 5
Finger up to knuckle joint or hand		$6 < e \leq 8$	≥ 20	≥ 15	≥ 5
		$8 < e \leq 10$	≥ 80	≥ 25	≥ 20
		$10 < e \leq 12$	≥ 100	≥ 80	≥ 80
		$12 < e \leq 20$	≥ 120	≥ 120	≥ 120
		$20 < e \leq 30$	≥ 850 ¹⁾	≥ 120	≥ 120
Arm up to junction with shoulder		$30 < e \leq 40$	≥ 850	≥ 200	≥ 120
		$40 < e \leq 120$	≥ 850	≥ 850	≥ 850

Note 1) If the length of the slot opening is ≤ 65 mm, the thumb will act as a stop and the safety distance can be reduced to 200 mm.

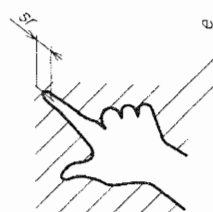
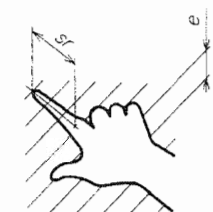
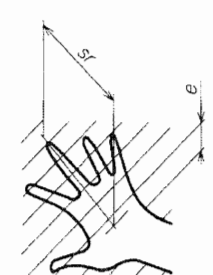
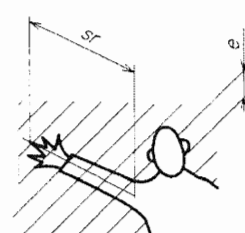
The dimensions of openings e correspond to the side of a square opening, the diameter of a round opening and the narrowest dimension of a slot opening.

For openings > 120 mm, safety distances in accordance with 4.3 shall be used.

4.5.2 Regular openings for persons of 3 years of age and above Table 5 considers the smaller dimensions of the thickness of the upper limbs and the behaviour of persons of 3 years of age up to 14 years of age. Persons above 14 years of age are also protected by using this table.

Table 5

Unit: mm

Part of body	Illustration	Opening	Safety distance, s_r		
			Slot	Square	Round
Finger tip		$e \leq 4$	≈ 2	≈ 2	≈ 2
		$4 < e \leq 6$	≈ 20	≈ 10	≈ 10
Finger up to knuckle joint or hand		$6 < e \leq 8$	≈ 40	≈ 30	≈ 20
		$8 < e \leq 10$	≈ 80	≈ 60	≈ 60
		$10 < e \leq 12$	≈ 100	≈ 80	≈ 80
		$12 < e \leq 20$	≈ 900 ¹⁾	≈ 120	≈ 120
Arm up to junction with shoulder		$20 < e \leq 30$	≈ 900	≈ 550	≈ 120
		$30 < e \leq 100$	≈ 900	≈ 900	≈ 900
Note 1) If the length of the slot opening is ≤ 40 mm, the thumb will act as a stop and the safety distance can be reduced to 120 mm.					

The dimensions of openings e correspond to the side of a square opening, the diameter of a round opening and the narrowest dimension of a slot opening.

For openings > 100 mm, safety distances in accordance with 4.3 shall be used.

NOTE : Measures for children's protection against strangulation are not the subject of this Standard.

4.5.3 Irregular openings In the case of irregular openings, the following steps shall be carried out.

- a) Determine first
 - the diameter of the smallest round opening, and
 - the side of the smallest square opening, and
 - the width of the narrowest slot openinginto which the irregular opening can be completely inserted (see figure 3).
- b) Select the corresponding three safety distances according to either table 4 or table 5.
- c) The shortest safety distance of the three values selected in b) may be used.

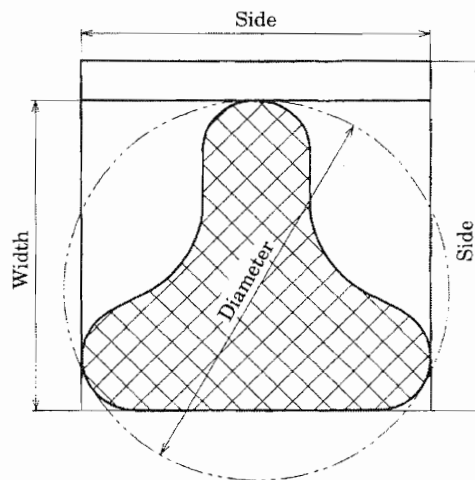


Figure 3

5 Effect of additional protective structures on safety distances In tables 1, 2, 3 (1st illustration), 4 and 5, the protective structures referred to are located in one plane. It should be borne in mind that additional protective structures or surfaces which function as such can reduce the free movement of the arm, the hand or the fingers and can increase the zone where danger points can be admissible. Examples of how this may be achieved are shown in tables 3 and 6.

Protective structures and surfaces upon which the arm can rest may be inclined at any angle.

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Errata will be provided upon request, please contact:

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